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Addressing Energy, Water, and Resilience Challenges in Small Island Developing States (SIDS) with an Optimal Mix of Renewable and Small Nuclear Power Sources

Small Island Developing States (SIDS) face unique challenges in securing electricity and water supply due to their limited land area, remoteness, vulnerability to natural disasters, and exposure to climate change. This paper suggests a low-carbon energy system to address these challenges, comprising renewable energy sources (solar and wind), battery storage systems, small nuclear reactors (SMRs), and reverse osmosis-based (RO) desalination processes.

As an illustrative case study, the paper presents a preliminary economic analysis exercise focusing on Cape Verde, a SIDS heavily reliant on imported fossil fuels for electricity generation and facing freshwater scarcity. The study compares the “business as usual” (BAU) scenario of continued dependence on fossil fuels with the proposed solution, based on the use of solar, wind, batteries, SMRs for power generation, and RO for desalination.

Using the Integrated Energy Systems Optimiser (IESO), we assess the economic advantage of the hybrid renewable and small nuclear power system by comparing the average prices associated with electricity and water supply with the BAU scenario. Key economic factors influencing the key economic indicators are identified, including the costs and financing terms associated with developing and deploying different low-carbon technologies.

This research acknowledges SIDS’s challenges in transitioning to resilient, low-carbon energy systems. Potential barriers include high upfront costs, limited financial resources, underdeveloped infrastructure, and potential public opposition. Additionally, specific considerations related to nuclear power must be addressed, such as safety and security, safeguards, and spent fuel management.

The study explores several strategies to overcome some of these barriers. Innovative financing mechanisms, such as green bonds and public-private partnerships, can mobilise capital. International organisations like the United Nations, IRENA and IAEA can facilitate knowledge sharing, capacity building and collaborative partnerships among SIDS, regional organisations, and the private sector.

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YES

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